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AN INTERPRETATION OF
WORK EXPERIENCE**

**Christine V. Bullen
John L. Bennett**

March 1990

**CISR WP No. 205
Sloan WP No. 3146-90**



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Abstract

Observers have identified a potential for major improvements in organizational productivity made possible through the use of personal computers serving as a means to link people into task-oriented teams. The study we conducted, given in overview form here, offers an early examination of how people are using personal computers for such electronic exchanges via networking. Our interviews of 223 people who were using several "groupware" systems in a sample of 25 enterprises indicate how they employ these software tools to support their group work.

We conclude that complex interactions of social and technical factors affect the use of groupware systems in organizations. We outline issues which both the developers of systems and the managers implementing groupware systems must understand in order to facilitate the design, introduction, and use of these systems.

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Groupware In Practice: An Interpretation of Work Experiences

I. Introduction

The fact that personal computer (PC) availability in the work place is growing at an astounding rate is being heralded from many corners:

"We're going from 11 million to 34 million PCs by 1994. PCs now make up about half the electronic keyboards in use but will account for 70% of the total in 1994." (Dalton, 1988)

"About 7 million PCs and 300,000 multiuser systems were installed in the United States by early 1985; and these numbers are still growing at about 15% annually. By 1985, there were terminals or microcomputers for at least 10 million people, or 20% of the United States' white collar workforce." (Kling and Iacono, 1988)

The usual assumption that the use of personal computers contributes to increased worker productivity is turning into an open question: Loveman reports that at a national economy level, researchers have failed to establish a significant relationship between information technology investments and increased productivity. (Loveman, 1988).

What aspects of PC use could contribute to measurable increased productivity? How do we get beyond the extravagant claims often associated with PCs to discover the reality of their value? Are changes in the organizational workplace or in the design of systems needed to bring the potential into actual realization? We believe that understanding how PC's are being used now can be important for understanding the value that PC's could potentially bring to the office environment.

One area where personal computers are being brought into use is to support the work of business teams.

"Business teams are becoming a way of life in many organizations... Business teams are seen by many as a wave of the future." (Bullen and Johansen, 1988)

"Traditional departments will serve as guardians of standards, as centers for training, and the assignment of specialists; they won't be where the work gets done. That will happen largely in task-focused teams." (Drucker, 1988, see also Reich, 1987)

Our particular focus is on looking at people who work in teams and are networked through personal computer workstations. We seek to understand the value that the technology brings to the office environment. We believe the quality of the results of using information technology to support group work has the potential to far exceed what is achieved today through the use of PC's by relatively isolated individuals within organizations.

If indeed team work is an important form of office work now - and will be more so in the future - then investigating how teams of people work and studying the use of personal computers in a team environment should be valuable for understanding how information technology is used and how this is affecting productivity in today's organizations. The MIT Commission on Industrial Productivity found:

"The third recurring weakness of the U.S. production system that emerged from our industry studies is a widespread failure of cooperation within and among companies." "... most thriving firms in the U.S.... have learned to integrate technology in their ... strategies and to link [their strategies] to organizational changes that promote teamwork, training and continuous learning." (Berger, et al., 1989)

The presence of PC's networked together in communication paths provides the physical infrastructure. But is a new kind of software needed to provide tools for team processes? A term which has become popular during the last few years is "groupware", a term applied to software that is intended to be used in support of interpersonal work within an organization:

Groupware is a generic term for specialized computer aids that are designed for the use of collaborative work groups. Typically, these groups are small, project-oriented teams that have important tasks and tight deadlines... Sometimes, groupware is used by permanent groups or departments...Group interactions may be formal or informal, spontaneous or planned, structured

or unstructured." (Johansen, 1988; see also Engelbart, 1963, 1968; Hiltz and Turoff, 1978; Stevens, 1981; Hiltz and Kerr, 1981; Kerr and Hiltz, 1982; Rice 1984)

Our questions about the use of PC's, the role of PC's when teams are linked through communications networks, the underlying issue of productivity, and the role of specialized software for use on PC's and workstations, all served as background as we began this research project. We used a case study methodology to investigate the current status of group work in organizations and to observe how computer-based tools were being employed in the facilitation of group work. Our purposes in this research are to develop insight on factors that should be influencing software design, and to report experiences that can help guide managers who put group support systems into practice.

II. Research Design

An interview framework served as a focus for data gathering. While the outline provided for initial distinctions we knew would be of interest, we let other distinctions emerge from our interviews. This work illustrates a research methodology often used by anthropologists and titled in a variety of ways, including "exploratory observation" (Malone, 1983) and "contextual inquiry" (Bennett, Holtzblatt, Jones, and Wixon, 1990). This type of study is not intended to be a controlled experiment or a large sample survey. The technique focuses on interacting with people in their own contexts as they do actual work. The goal of data gathering is to obtain insights through observation, interviews, and interaction. The challenge of this methodology is that it relies on the skill of the observer to accurately report and interpret, while allowing unexpected phenomena to emerge from the examples studied. This approach often results in uncovering research questions which can be investigated through controlled experiments or additional contextual inquiry. Our conclusions present such opportunities for further research.

Table 1 outlines the topics that served as a framework to guide the interview. In this paper we summarize, synthesize, interpret, and present points salient to us. Therefore, we do not present data in each category shown on the interview outline.

We used the interview outline as we spoke with two hundred and twenty-three people in twenty-five organizations, represented at thirty-one sites (see Table 2 for details on companies, number of interviewees, and groupware systems available in each). Each interview lasted a minimum of one hour, with the longest interview lasting two hours. In almost every case, the interviews were carried out in the individual's office or work area.

The twenty-five organizations represented a wide range of industries and size of companies. We chose organizations in which groupware systems were available, and those systems helped to define the set of groupware systems that we studied. Organization names are coded, as our agreement with those interviewed guaranteed confidentiality. We consulted with each organization to choose groups for our interviews that met the following criteria:

- ▶ cohesive business teams, facing challenging environmental conditions which would emphasize the importance of coordination for achieving their goals and objectives;
- ▶ teams that had some form of information technology available to support the work of the group.

The size of our work groups ranged from seven people to thirty-five people. Those interviewed included individuals at all levels of management within the target work group and, where appropriate, support personnel (administrative assistants and secretaries). In most organizations, the managers to whom the work group reported were also included as part of the case study to help establish some of the contextual information.

GROUPWARE

Case Study Interview Outline

General background information on the organization, the work group, and the individual being interviewed;

Detailed information on the work group or project:

- o Members
- o Description
- o Mode of operation:

meeting frequency

forms of communication (face-to-face, phone, electronic, video)

levels of stress

leadership

boundary management (relationship to world outside project);

Description of how tasks are accomplished;

Determination of information technology (I/T) tools that are used to facilitate task accomplishment with detailed description of use;

Determination of general sense of satisfaction with existing mode of operation;

Suggestions for change;

Probing of interviewee's sense of the future:

- o Types of group work that will take place;
- o Changes anticipated for organization as a whole;
- o Needs for different I/T tools.

GROUPWARE

**Companies Studied with Revenues,*
Number of People Interviewed, and
Groupware Systems Available**

COMPANY	REVENUES IN BILLIONS	NUMBER OF PEOPLE INTERVIEWED	GROUPWARE SYSTEMS
BigChem	\$30.00	8	PROFS, Higgins, The Coordinator (V.I)
SapCo	17.00	30	Other, Metaphor, ForComment
InsurCo	12.00	5	PROFS, Higgins
OilCo	11.00	5	PROFS
ExploreCo	10.00	3	Other
ConstrucCo	10.00	3	PROFS, Other
FoodCo	9.60	3	PROFS, The Coordinator (V.I), Higgins
TerminalCo	9.40	10	All-In-1
RBOC	8.40	10	PROFS, Higgins
HealthCo	8.00	20	All-In-1
BankCo	6.80	5	All-In-1
MedCons	6.00	3	PROFS, ForComment
LawCo	5.00	3	Higgins
ServBuro	4.40	13	The Coordinator (V.I)
SnackCo	2.00	35	The Coordinator (V.I), Other
BeerCo	1.40	6	Metaphor
SmallCons	1.40	10	Other
CableCo	1.00	15	The Coordinator (V.I)
SmallChem	1.00	5	The Coordinator (V.I)
PubServBuro	0.90	3	PROFS, Other
TransDist	0.18	10	The Coordinator (V.I)
SmallRes	**	3	Other
IndCons	**	2	The Coordinator (V.I)
StateBuro	n/a	3	PROFS, ForComment
BigU	n/a	10	PROFS, ForComment, Other

Profs available in many places; studied in 2

*Revenues approximate, 1988

**Revenues less than \$1 million

We did not choose our groups for study on the basis of a statistically random sample. We contacted potential research sites on the basis of referrals and our own knowledge of their use of technology. However, the resulting sample is drawn from a wide variety of industries, and it includes a wide range of organizational sizes and geographic dispersion. While these characteristics do not guarantee that the results can be generalized, they do suggest that we are not seeing isolated and unusual instances of groupware tool use.

Conducting a study of work groups raises some interesting questions about how to define inclusion in a work group. What are its bounds? Work groups have been defined as "identifiable and bounded subsystems of a whole organization [with a] recognized purpose, which unifies the people and activities." (Trist, 1981); "collaborating groups of information workers" (Bikson, et al, 1989); and "multiple individuals acting as a bounded whole in order to get something done" (Rousseau, 1983)

We found a variety of organizational forms constituting work groups. For example, at CableCo the work group coincides with the organizational department, although it is spread geographically across the continental U.S. At SmallCons, the "work group" consists of the entire firm. And at SoapCo, the work group is a flexible concept such that at times it involves an organizational entity at one location (e.g., the Boston marketing group), while at other times it consists of the worldwide instances of the organizational entity (e.g., all marketing groups), and under still other circumstances, the work group is a subset of entities (e.g., Boston, Chicago, and San Francisco marketing groups).

In the world of electronic communications, the composition of work groups is showing important changes from those observed in the past. Because of flexibility provided by communication technology of all kinds, it is becoming more difficult to identify a formal organizational unit as a work group. That is, some people co-located in an office area do not necessarily work together as a group, and people geographically separated may form a team focused on achieving a common work result. Through the

power of electronic media, these groups are dynamic and fluid; this is true for both formal and informal organizational units.

"The traditional concept of an 'organization' is no longer useful to managers or students of organizations. It is dominated by models of structure and physical identity at a time when telecommunications has eroded the boundaries between firms and changed the nature of coordination across geographic location" (Keen, 1988)

Given our research interest in the factors important for software specifically designed for use by teams, we had to develop a working definition of what constitutes "groupware." This term often is used to indicate computer software that is intended to support interpersonal work within an organization. Early notions of groupware saw a clear connection between the software tool and the group processes. However current manifestations of groupware tools appear to focus on the technical qualities of the functionality and may, in effect, ignore the dynamics of group use.

We have employed a broad definition in our research in order to accommodate the evolving nature of this field. In time, the term groupware will probably be narrowed to include only those tools specifically designed to support group work. However, at the present, it is useful to include all tools being used to support group work, even if the tools represent user adaptation of an existing technology (e.g., group agreement to share files and calendars on a system designed to keep such functionality private). Therefore, our working definition of groupware is: computer-based tools that can be used by work groups to facilitate the exchange and sharing of information.

There are a large number of systems with a large variety of functionality, which fall under this groupware umbrella. Figure 1 illustrates a framework for organizing these systems using the dimensions of time and place to create four domains which describe circumstances of interpersonal work (Bullen and Johansen, 1988):

- ▶ same time, same place
- ▶ same time, different place
- ▶ different time, same place
- ▶ different time, different place.

While each of these domains is important and the four are interdependent, for this study we decided to investigate those computer systems which can be used to facilitate work in the different time, different place domain.

III. Information Technology Tools Studied

In the course of the case studies, we focused on the use of eight different information technology systems at various times and various locations. The choice of the specific systems was influenced by their presence at the organizations that agreed to participate. Within the various systems a number of functions can be considered as tools that can be used for support of groups. In order to describe these systems broadly, we make the following generalizations. All of the systems studied provide the following functionality (summarized in Table 3):

- Construction/Editing Facilities: All systems provide at least a rudimentary text creation and editing facility. Some include elaborate editors and provide function to import graphics. One special purpose system (ForComment) focuses on joint authorship and editing as an aspect of group work.
- Electronic Exchange of Text: This includes electronic mail and/or conferencing, gateways to other systems (both internal and external, e.g., facsimile transfer), and document transfer. As a result of the text being captured in a computer-

Figure 1

SAME TIME

DIFFERENT TIMES

SAME
PLACE

Meeting Facilitation
Group DSS Room

Presentation
Project Management
Team Room

DIFFERENT
PLACES

Conference Calls
Video Conf
Screen Sharing
Spontaneous Mtgs

Email
Computer Conf
Collab Write
Conversational Struc

GROUPWARE

**Functionality Provided
in Groupware Tools**

- ▲ Construction/Editing Facilities
- ▲ Electronic Exchange of Text
- ▲ Directory
- ▲ Time Making/Time Keeping
- ▲ General Tools

readable form, the content can be reused, edited, re-sent, etc. Capabilities with respect to exchange of graphics, images, and spread sheet data differ in different tool environments. Some of the tools provide ways to manage the exchange of text through folders or through automatically linking related messages.

- Directory: This functionality at a minimum provides a name and electronic address file to support data exchange by users of the system. Some of the tools provide a traditional "little black book" functionality, where extensive data on mailing addresses, multiple telephone numbers, and notes about individuals (e.g., secretary's name) can be stored.

- Time Marking and Time Keeping: All the tools except one (ForComment) provide a facility for recording events scheduled for a particular date. The capability ranges from this basic task to for example, recording repetitive events, reminders, "to do" lists, and linking this data to other system functions.

- General Tools: Some of the systems provide tools for the support of work in financial and budgeting areas, and because of the ways in which the tools can be used, support some project tracking capability.

Integration across the functionality provided is an interesting concept in groupware research for two specific reasons:

1. We found people hindered in the use of tools because of problems associated with the degree of integration;
2. This term is used imprecisely by both vendors and users as a measure of quality in describing groupware systems. Therefore it showed up often in our interviews and we feel there is value in defining integration and exploring its application to these systems.

The concept of "integration of function" needed for support of group work is a relative term. One aspect of integration can be measured by examining the process

required for each user to move freely between functions, and by looking for the presence of system-dictated steps (e.g., log off from one function, log on to another function). Another aspect is the extent to which the software enables the user to move data from one function to another without requiring special transformations. Thus, integration, as we use the term, refers to the **flow of control** during work by an individual or by team members, and to the **flow of data** during the process of individual interaction with the software or during interaction among team members.

Integration within and across the functional categories listed above differed significantly among the various tools. As a result some of the systems resembled a group of functions rather than a cohesive package.

Brief descriptions of the individual systems appear in Appendix I. Table 4 shows a list of the systems and which of the general categories of functionality are provided in each. We do not provide here specific information on the details of operation for each tool. The range of capability is wide in terms of search mechanisms, ordering rules, etc.

IV. Observations, Key Issues, and Conclusions

In this section we summarize the results of our study. It is important to understand, that because of the complexity of intervening factors, the observations we report here do not have simple explanations. Research by Iacono and Kling (1988) and Markus and Forman (1989) supports the notion that we need to take multiple perspectives in performing research in organizations. We have found the framework suggested by Iacono and Kling (shown in Table 5) to be particularly useful to us as we sorted out factors influencing the adoption of technology. From a tool perspective, technical solutions are offered as if the innovative benefits of the function would overshadow any

GROUPWARE

Tools Studied

CONSTRUCTION/ EDITING FACILITIES ELECTRONIC EXCHANGE OF TEXT DIRECTORY TIME MARKING/ TIME KEEPING GENERAL TOOLS

	CONSTRUCTION/ EDITING FACILITIES	ELECTRONIC EXCHANGE OF TEXT	DIRECTORY	TIME MARKING/ TIME KEEPING	GENERAL TOOLS
<i>All-In-1</i>	Yes	Yes	Yes	Yes	Some
<i>ForComment</i>	Yes	Specialized	Specialized	No	No
<i>Higgins</i>	Yes	Yes	Yes	Yes	Yes
<i>In-House System 1</i>	Yes	Yes	Specialized	No	Some
<i>In-House System 2</i>	Yes	Yes	No	No	No
<i>Metaphor</i>	Yes	Yes	Specialized	Some	Specialized
<i>PROFS</i>	Yes	Yes	Yes	Yes	Some
<i>The Coordinator (V.I)</i>	Yes	Yes	Specialized	Yes	Some

historical, political, and social factors that might be present in the environment. Instead, Iacono and Kling find that the environments into which computer-based tools are introduced should be viewed as institutions. As institutions, the environments exhibit many barriers to adoption that have little or nothing to do with the technical merits of the innovative tools. Consideration of historical, political, and social factors can forewarn those developing tools and those introducing them into the environment where computer-based support is provided:

"We conceptualize these patterns as the social organization of computing. We define 'social organization of computing' as the choices about computing (both social and technical) which become embedded in work environments and which are experienced by the users as part of the social practices in their everyday work world." (Iacono and Kling, 1988)

Other researchers have stressed the importance of understanding the balance between a technology perspective and an organizational one. Bikson, et al. (1989) comment:

"...group members are interdependent not only on one another but also on the technology, and technical and organizational issues are closely interrelated. The more advanced the information-handling tools provided to the group, the more critical it becomes to give equivalent and concurrent attention to the social processes through which these tools are deployed, and to seek a mutual adaptation rather than maximization of either the social or technical system in isolation." (p.89) (See also Mumford and Ward, 1968)

In making our observations and drawing conclusions we were struck by the importance of understanding the complex interplay of factors which influenced the specific organizations we studied. However, in order to simplify the presentation of our conclusions we have sorted them into two categories:

1. From a Design Perspective - In this category we discuss those conclusions which designers ought to take into consideration when conceptualizing functionality for groupware systems. Our conclusions suggest that while designers must be concerned

GROUP WAR

Iacono and Kling Framework

	Tool Perspective	Institution Perspective
Historical <i>past decisions what may limit future actions</i>	Assume freedom from past; focus on future technology perfection; less attention to present; assume individuals free to move in new direction Groups less a factor.	Interests served in past are present in current situation; those commitments constrain future choices; individuals assume current activities will persist; interdependence of groups.
Political <i>control over access to resources</i>	Local control and self-interest assumed paranoid; potential conflicts rarely recognized, assume power of technology will overcome political barriers	Shared control and shared interest groups recognized; specialization limits possible changes; organizational structure (social-structure) may hinder adaptation and survival.
Social <i>soft skills, patterns of control and discipline</i>	Local and simple negotiating context without constraints from other sources.	Complex and overlapping negotiating contexts within and among groups.

about the technical solutions, they need to go beyond the "tool perspective" to include an appreciation for organizational factors that may influence the use of groupware systems.

2. From an Organizational Perspective - In this category we discuss those conclusions which management ought to take into consideration when planning for and implementing groupware systems. These conclusions suggest ways in which managers could anticipate organizational factors which might influence the groupware implementation process and subsequent use. However, managers must also be careful to not fall into a pure "institutional perspective" to the exclusion of concern about the quality of the technical solutions.

As with any categorization, this dichotomy of conclusions is an oversimplification. There is considerable overlap in the groupings. We do not intend to imply that designers will not find useful information in the second grouping, nor that managers will not benefit from the conclusions in the first category.

As interviewers, observers, and interpreters of these work experiences, we have been conscious of these perspectives. In the following discussion of key issues and conclusions we support the ideas using observations and quotations from our field work. Some of the researchable questions which emerged are suggested in each section. However, others can be formed from the work reported here.

IV.1. FROM A DESIGN PERSPECTIVE

IV.1.1. Electronic message communication is the primary tool.

The functionality for sending and receiving electronic messages, available in all of the products we studied, was far and away the one aspect of groupware that was heavily used and universally stated as valuable.

"I love this tool. I can reach people and they can reach me anytime, anywhere and discuss anything." (SnackCo)

The desire to have support for communication within a work group was usually the primary motivation for acquiring the tool. People quickly grasped the idea and procedures associated with electronic messaging in contrast with their failure to use many of the other functions available in these systems. The simple presence of function in a groupware tool does not in any way mean that it will be used. In each system we studied, several of the available functions were ignored by the using groups. However the electronic messaging capability, regardless of its user interface design, ease or difficulty, or level of sophistication was used extensively. In several instances interface features were either ignored or adapted by the people to accomplish a simplified process of communicating electronically.

For example, the interface provided by The Coordinator (Version I) contains language related to the underlying theory of speech acts (Searle, 1969). This language is intended to lead the users to think about what they are doing and to characterize the communication as one of several choices, e.g., a request or promise, etc. While the software provides a choice for simple e-mail (called "free form"), we found people consistently sending each other "requests" regardless of the content of the message. Not surprisingly, "request" is the first menu choice and where the cursor falls by default. Many people we interviewed reported that they ignored the choices and just "hit enter" to send a message. However, they had high praise for the tool:

"The Coordinator gets the information out!" "The Coordinator opens communication lines." (CableCo)

"The Coordinator's major advantage: instant communication with a large audience." (SnackCo)

In another example, the user interface for Higgins electronic mail walks the user through a series of steps to answer questions about how to assign key words, follow-up dates, etc. A person using Higgins to help manage information or for sharing messages in the groupware sense, would answer these questions. However, the users we observed skipped through this menu leaving blanks in most categories. People reported that they

understood the value of the categories, and knew that they "should" be filling the blanks, but that they were in a hurry and just wanted to get the message sent.

One possible response to this observation is that the message-flow needs of work groups are so great that they overshadow the other system-based activities. This immediately suggests that we need a definition for this kind of communication which, on the basis of what we observed, could be termed sending and receiving messages. Any of a number of the tools provided as part of a groupware system can be also thought of as entering into "communication" in the sense that they can be used to support transfer of information in some way, for example:

- ▶ calendar entries
- ▶ expense reports
- ▶ reports of project status
- ▶ telephone directory
- ▶ spread sheets
- ▶ budget reports
- ▶ tickler files/to do lists

It is interesting to note that these particular functions tend to be separated from electronic messaging in the information technology tools themselves. We do not support this distinction as "correct". However, as we observed and interviewed people, we found that they acted as if this separation of functionality was real for them, and they generally spoke in terms of "e-mail and the other things the system can do."

This raises the interesting point of how to distinguish between what people say they do with information technology tools (or want to do) versus what people think they should or should not do because they have been influenced by the tools at hand. We cannot answer this question definitively. We can, however, say that given the choices existing in information technology tools today, the people we studied used what we are calling "message functions" almost exclusively.

Our interviewees frequently stated that they chose groupware systems because of the mix of functionality offered. Given that, an important question is: why do they not use most of the functions.

For example, users say they want groupware tools that provide calendaring functions. Yet in the majority of organizations we studied the calendar tools were not being used. People gave a variety of reasons; the net result is the fact that although the desired function was present, this did not in and of itself mean that it was used.

"We thought having the calendaring function available on Profs would be useful in organizing meetings, but no one has taken the time to learn about it." (InsurCo)

"One of the reasons we chose Higgins was because of the wide range of functionality it provides. However, most people just use the e-mail." (RBOC)

If developers commit resources to provide function, it is important to understand what is seen by users as a barrier between "offered" (by the system) and "used" (by the people). Other factors, as we shall report, were important in determining whether a function was used.

In conclusion, our field observations show that the tool people use the most is electronic messaging. If we can assume that these busy people would use the portions of the systems that they need the most to accomplish their work, we may conclude that what they need the most is electronic messaging support. In the following sections, however, we discuss other factors that increase the complexity of forming this conclusion. A researchable question here revolves around gaining a better understanding of the value to the user of the electronic messaging function as compared to the value of other functionality. Another research topic raised by this conclusion is understanding the barriers to effective use of the functionality other than electronic messaging.

IV.1.2. Message linking is a key improvement provided by electronic communications.

One aspect of electronic message communication that was emphasized in our interviews was the ability to link messages concerned with one subject area or a distribution list. This functionality is provided in two of the tools (Higgins and The Coordinator) and it is also inherent in the concept of computer conferencing, which is available in All-in-One (VAX Notes) and in In-House System I.

Computer conferencing organizes all electronic messages according to topic areas. Therefore when a message is composed and sent, it is addressed to a topic. The concept of a "topic" is not limited in any way, and can in fact represent a project, general discussion, software release, distribution list, individual, etc.

People reported in our interviews that they gained much value by being able to "look in one place for all discussion pertaining to project XYZ." In contrast to this observation, users of e-mail systems like PROFS and All-in-One (without Vax Notes), complained about the difficulties of tracking down related messages and managing their mail folders (i.e. files for grouping messages by categories).

Message linking provides four primary values:

- ▶ collection of notes in one place
- ▶ chronological record
- ▶ ability for latecomers to view an entire record of interaction
- ▶ knowledge of the "right" place to put new messages.

In The Coordinator (Version I) this functionality is embodied in a concept basic to the underlying theory: the "conversation" is the primary unit of interaction. Because of this, each time someone replies to a message, the reply is automatically linked to all previous messages in the stream and becomes part of the "conversation."

"I use the traceback function a lot to find out how we arrived at a particular point in the conversation." (SnackCo)

"If I receive an answer to my request that is not linked, I get annoyed because it messes up the ability to follow back through the conversation." (CableCo)

This feature of The Coordinator came out in our interviews as one of the most valuable aspects of the tool for these users.

Our interviews showed clearly that people value the ability to group and link messages that are related by subject. This "computer conferencing" capability has been available for more than fifteen years in electronic communication systems (Johansen, 1988). However, general understanding of how it works and general availability to users has been limited. It remains interesting to us that this functionality should be singled out by many users as a key benefit of groupware.

Historically, knowledge workers have always sought ways to organize the volume of information they have manage. The first major innovation to affect this process was the vertical file system (the file cabinet, in 1892) which facilitated the grouping of correspondence by subject:

"[Vertical files] had several advantages over [other forms of filing]. Most importantly, the folders allowed related papers to be grouped together and easily removed from the files for use." "The new equipment alone was not enough to make storage and retrieval efficient. In a textbook on filing published by the Library Bureau, vertical filing of correspondence was defined as including the *organization* of papers in the files, as well as the filing apparatus itself: 'The definition of vertical filing as applied to correspondence is -- the bringing together, in one place, all correspondence to, from or about an individual, firm, place or subject, filed on edge, usually in folders and behind guides, making for speed, accuracy and accessibility.'" (Yates, 1989)

In effect nothing has changed: groupware message linking or conferencing allows people to carry out this task for electronic correspondence!

The need represented in our interviews, (i.e., focus on the value of message linking), is one which should be carefully investigated by both designers and implementers of groupware. People use message linking to:

- ▶ manage communications
- ▶ keep records
- ▶ develop "group memory"
- ▶ exchange documents.

This conclusion may be telling us a great deal more than what is at first obvious: rather than looking at "fancy," innovative functions for groupware systems, designers should be focusing on how to better solve the basic need of office workers, i.e., to manage large volumes of information. There may well be ways other than those we see today for designers to address these needs and better serve the groupware user.

IV.1.3. What functionality is included and how it is offered are important factors.

It became very clear through our interviews that people did not use some of the functionality in groupware systems because of the design of the tool. There are two characteristics of design quality which we observed.

IV.1.3.1. What functionality is included.

One of the best examples of functionality requested by "the marketplace" but not used effectively is the calendaring function. The explanations we were given in our interviews focused on one fact: electronic calendars in their current form can not replace traditional paper ones. The topic of electronic calendars would justify a separate paper, but we can summarize some of the key problems.

- Traditional calendars are not simply places where you record times for events to take place on dates, though electronic calendars are usually limited to such a simple function. Traditional calendars have notes on them, contain telephone numbers, are often color coded, and have other papers attached (such as yellow sticky notes or paper-clipped memos, letters, etc.). The non-homogeneity of traditional calendars is actually an asset for finding important information (there are parallels here with Malone's (1983) findings on desk organization).

"I honestly tried to use the calendar in Higgins, but I found it frustrating to not have my familiar book with all its messy notes, colors, and paper clips." (RBOC)

- Electronic calendars are not portable, and paper copies of the information contained in the computer are inadequate substitutes. Notes made on the paper copies often do not get keyed back into the computer-based version.

"I need a portable calendar for traveling. My secretary makes me a copy of the computer one for trips, but it is ugly and hard to read. Then I have to make notes on it and do not put them in the computer, and everything gets out of sync for a while." (HealthCo)

- The group calendaring value of electronic calendaring is lost unless everyone cooperates. People do not have an incentive to maintain their calendars in such a way that they support group use. In addition, people object to the notion that others (not their secretaries) may schedule their time.

"We tried to use it to schedule meetings and found that several guys weren't keeping their calendars up to date. So almost as many phone calls get made and it takes just as long." (ConstrucCo)

- The process of setting up meetings is not always a mechanical one. There are times when negotiation is required to secure the presence of all desired parties.

"When we set up meetings we have to go through lots of negotiation since the Board is made up of members from many locations. Dates for regular meetings get established well in advance and put on everyone's calendar. But setting

up special meetings requires lots of personal contact.
(TransDist)

- Very often those who take time to input the information never gain the value of group calendaring because others (usually secretaries) do the group scheduling. Therefore people see a basic economic imbalance of input effort to output value (see also Grudin, 1988).

"It seems I do all the work and Harry's secretary gets all the benefits!" (BigU)

IV.1.3.2. *How the functionality is offered.*

The second aspect of functionality relates to the way it is offered to users. Aside from the functional limitations mentioned above, calendaring was not used in several of the systems because people found the process of use awkward (e.g., no easy way to indicate recurring events). In other examples people reported that they could not use a tool effectively because they could not remember how to access a particular function and could find no effective help on-line or in the written manuals.

Aspects of the user interface design were also important factors in the reaction people had to The Coordinator (Version I), (see also Bair and Gale, 1988). While people in fact used the package, and stated that the product was valuable to them:

"It's great for communication breakdowns since you can back track the conversations and find out what went wrong." (SnackCo)

they also commented on the terminology of the interface:

"I am not enchanted with the verbiage." (ServBuro)

Two other products, ForComment and Higgins, were consistently praised for their interfaces, even though some other aspects of their designs were criticized.

"ForComment is a joy to use; its so easy to understand the menu items without a manual or checking 'Help'." (SoapCo)

"Higgins menus are self-evident, and the use of color is really nice."
(RBOC)

It has long been recognized that user interface design is a critical element in the successful use of a software product (Martin, 1973). Therefore it is not surprising that it continues to be an important element in the case of groupware tools. However, it may be that because people in a work group use these tools, additional factors must be considered in interface design. For example, in a single-user product, like the spreadsheet, designers must be concerned about how each user interprets menus and takes action. In a groupware tool the designer must be concerned about the individual user, and in addition, must address the issue of how what that user does is interpreted by many others, individually and as a group. Additionally, the individual is acting as a representative of the group which may influence how the tool is used and interpreted:

"It is important to note that an intergroup transaction is not the same as an interpersonal one, although both take place between individuals. A group member involved in intergroup transactions acts as a representative of the group in accordance with the group's expectations. The member is not acting solely on an individual agenda." (in Ancona, 1987)

For example, one person may choose to use an all-lower-case character style to indicate "informality" in notes. This style may be detrimental in communication if other users interpret this as not having enough concern to compose a note properly. The judgment of this user's behavior can then be made not only against that individual, but against the group as being, for example, "unprofessional." Such issues introduce many more layers of complexity into the interface design process, and they emerge from a social analysis of our interview data rather than an analysis which looks purely at the technological merits of design.

In conclusion, it is clear from our interviews that the quality of design, both in terms of functionality provided and access to that functionality, is an important factor in how and whether people use groupware tools. The researchable questions which are suggested by this conclusion focus on gaining a better understanding of 1) interface design in software that serves a team of users, and 2) the actual tasks carried out by individuals acting as members of groups.

IV.1.4. Isolated tools hinder productive use of groupware systems.

The tools are considered isolated with respect to the flow of user control during work and with respect to the flow of data among tools (as discussed earlier). In some cases the process of accessing the function of a second tool when using one tool (i.e., flow of control) requires an awkward sequence of user actions. Other cases require the transfer of data from one tool to another (i.e., flow of data). (See also Nielsen et al., 1986)

Transfer of User Control - In several of the organizations we studied, it was necessary for the people to go through a series of steps in order to move from the groupware tool they were using for their business group/team to other tools they were required to use for tasks relating to the firm as a whole. For example, some groups used a personal computer e-mail system like those available on Higgins or The Coordinator within their departments, but they had to change to a mainframe-based tool like Profs or All-In-I to use e-mail in other parts of their companies. This was universally considered to be an aggravation and a waste of time, regardless of the ease or difficulty associated with the switch.

"I want to log on to The Coordinator and Excel at the same time because I need to bounce back and forth from moment to moment." (SmallChem)

"Because Forecasting uses Metaphor to analyze sales data from last year, pricing people are using HP3000's, and I have my analysis programs on a Compaq 386, I have a heck of a time moving between functions I need to access when we set up a promotional campaign." (BeerCo)

"It's such a pain, I actually have to crawl behind my desk and change plugs. Is this modern technology??!!" (SnackCo)

Transfer of Data - Tools that were not completely integrated required that the result from one task be consciously moved into the environment of another tool in order to perform additional tasks. Most users were annoyed by this step, irrespective of its ease or difficulty. From the examples given above to illustrate flow of control problems, it is clear that transfer of data is also a problem at some of the sites.

"I know it is hard to believe, but we actually have to print the output from the HP3000 programs and key the data in to the Compaq 386 because we haven't found a more cost-effective way to move the data across directly." (BeerCo)

The ForComment system, highly praised in most respects, was singled out here with respect to data transfer. In order to use ForComment, the person must import text created elsewhere. Although this is a straightforward step, users consistently commented that they would prefer that the functionality provided by ForComment be available as part of the word processor they used to create the text.

"I love ForComment, but I wish it were part of our word processing package. I am always afraid something will get lost in the transfer, so I take the time to check the whole document." (BigU)

With respect to both flow of control and flow of data those interviews showed very clearly that a lack of integration from either integration perspective was a barrier to their use of some groupware tools. In addition Ancona's (1987) research on boundary management (i.e., the management of the group's relations with environments and individuals external to the group) raises an interesting point with respect to flow of control. She found that, for teams equally matched on group process characteristics, their performance could be differentiated based on their boundary management capability. This finding would imply that boundary management is a key aspect of team performance and, therefore, productivity. If teams are using groupware systems that interfere with their ability to perform boundary management (e.g., the team e-mail system is not easily

connected to the organizational e-mail system), their productivity may be adversely affected. From this we conclude that productive use of groupware is reduced when the tools are isolated.

IV.2. FROM AN ORGANIZATIONAL PERSPECTIVE

IV.2.1. People report most value from tools that parallel their non-electronic activities.

Those we interviewed reported that e-mail, for example, was "easy" because it was analogous to, but better than, what they did without groupware tools. People saw computer messaging as an improvement over "the old way" because it was faster, traceable, geography- and time-independent, and accessible from almost any location (e.g., at home, while traveling). Therefore it was easy for people to see the benefits to them in learning how to communicate electronically.

Other functions provided by the systems either differed significantly from what people saw as needed (e.g., electronic calendars) or presented capabilities that they were not currently employing. In the latter category, functions such as project tracking, reminders, directories, and expense tracking all represent tasks that the people interviewed were not undertaking. Therefore, to use the electronic version of these tools was actually requiring them to expend resources for activities they did not normally carry out or carried out only infrequently.

We therefore conclude that the designers of, developers of, and those who introduce groupware tools are presented with an interesting challenge: how are people going to make the transition to new practices which some of the functionality enables? Part of the answer to this question lies in designing functionality that is easy to learn and remember after long periods of non-use. Another part of the answer, however, is found in the organizational considerations which address the need to examine current work processes.

IV.2.2. Benefits gained need to balance or outweigh the invested resource.

The benefits from some of the functionality (other than that provided for messaging) were not clear, nor balanced in our interviewees' minds. In fact users often saw more effort on their part for not as much gain.

For example, people saw the work involved in maintaining an electronic calendar as redundant (since most also wanted to have a portable calendar on paper), and as benefitting others in the organization who did meeting scheduling. They likened their maintaining calendars and project information to "keypunching" activities. Although they agreed that their managers and groups would benefit, the benefit to them personally was too far removed to motivate their behavior.

Messaging functions, however, had a beneficial impact on them directly. They experienced the satisfaction of "getting the message out," "putting the ball in the other guy's court," assigning tasks to group members, etc. On the receiving side, they had a record of what they were expected to do, and through being on copy lists, had a sense of being in touch with what was going on in the group. They had no need to conceptualize anything beyond a personal benefit.

Other functions as mentioned previously (e.g., project tracking, reminders, etc.) actually required additional effort on the part of the users to learn to do things in a different way, independent of the technology. While the people we interviewed often said things like "I should do expense tracking", "I know it would be more efficient if I kept an electronic directory", "I could really benefit from the reminder function", invariably they were unwilling to adapt their behavior and invest the personal resources necessary to employ this kind of functionality. They had not identified benefits to using the technology which equalled or exceeded their resource investment.

Therefore, we can conclude that unless there is a balance between the effort required on the part of the user and the benefit delivered to that user, a person is not likely to employ the functionality present in a tool. Other forms of motivation (e.g., management directives, group agreement, education) can be important in influencing the perception of balance. (See also Grudin, 1988.) Research to investigate motivation and change management as part of the implementation of groupware technology could be beneficial in understanding the dynamics here.

IV.2.3. Groupware implementation is simultaneously a social and technical intervention.

Our research observations support the ideas offered by Kling and Iacono (1988) that "computerization is simultaneously a social and technical intervention." One of the most important aspects of this complex intervention is that it is a "strategic intervention" (Kling and Iacono, 1988, p.8). Whether the strategy of technology introduction is made explicit or kept implicit, it exists and can have a significant impact on the organization.

In our research we saw the effects of strategies on the individuals we interviewed. For example, when a groupware system was introduced as a way to streamline procedures by merely training new users in the mechanics of the tools, we saw people using a minimum of the functionality present in the systems. That is, people used what they were taught to use without any innovative thinking on their parts about either, 1) how to employ other functionality present in the groupware systems, or 2) how to creatively use that which they had learned to have an impact on the way they carried out their work. When instruction went beyond mechanical steps, however, to include, for example, a presentation on the concepts of groupware, or material on how to relate the groupware functionality to accomplishing their work tasks, then people made use of, and applied creative thinking to using the functionality present in the tool.

When a groupware system was introduced as a new technology to experiment with, the people did not take it seriously and did not look for ways to augment their

productivity. When decision makers held high expectations for productivity enhancement through groupware, yet gave no attention to examining the work process, people reported that they felt under pressure to perform better while learning a new tool and without a clear understanding of how the tool would make a difference. In many of these cases, the introduction of the groupware system had a negative effect on productivity.

Organizational factors showed up as consistently important as we interviewed people in the twenty-five firms. We report our observations in the following four general categories.

1. Champions. Management support for the introduction of groupware tools varied significantly in our sample. In some organizations, support for the tool emanated from the top levels of the firm:

"When the president wanted us to use this e-mail package without even looking at any others, we thought it was strange, but had enough faith in [him] to try it." (CableCo)

At others, like SnackCo, the management support was at the departmental level:

"We thought this tool was weird, but if WW asked us to try it, we knew it was worth doing."

In some instances, the support came lower in the organization in the form of middle management supporters who felt they could engineer successful pilots and demonstrate the value of the tools to upper management:

"Through my own coaching and interpersonal skills I have been able to teach people and win them over to the value of using The Coordinator. Now management is paying attention." (ServBuro)

While these instances of managerial support represent very different levels of power within each organization, they demonstrate the importance in general of a committed leader in the introduction of a new technology. Management literature for decades has

discussed the value of leadership and champions for the successful implementation of an innovation. In the area of groupware tools, this "common wisdom" continues to be valid. However, as the previous observations have shown, and the next observations will suggest, managerial support cannot guarantee successful implementation by itself.

2. Expectations. We observed two different work groups in one organization in which the same software had been introduced. In one of these groups (Group A) the tool was originally described as a new technology that the group members should familiarize themselves with and see what they could use it for. In the other group (Group B) the tool was described as an important new technology that was going to be used to improve communication throughout the organization. Five years later, when we conducted our interviews, the original attitudes were present in these two groups and were influencing the use of the software. As a result, in Group A the tool had never been taken seriously and was still considered "an experiment" and informal. In Group B the tool was described by people as "critical to their jobs."

It is clear from our studies and those of others "that the kinds of expectations with which an organization approaches new information technology do much to define the consequences that will be observed." (Carroll and Perin, 1988). Therefore the way in which new groupware tools are introduced into the work group will influence the ways in which they are used.

3. Training. Those interviewed generally described the training that they had received in the use of their software as directed toward building procedural or mechanical skills. By this we mean they reported basic instruction in what keys to push to accomplish specific tasks. This was true for all the tools we studied. However, in the case of The Coordinator, we did interview some users who had received training that included an introduction to the theory underlying this product. A subset of this group did report that the ideas were too sophisticated for them and their colleagues to assimilate:

"The linguistic concept went over most peoples' heads." (SnackCo)

"The training left me cold, but we pursued the value on our own."
(CableCo).

However, some reported that knowledge of the theory helped them to use the tool and to implement the communication practices which the tool supports:

"Knowledge of speech-act theory has really helped me use The Coordinator to be more effective in my daily communication." (ServBuro)

"The workshops were inspirational and make using The Coordinator vocabulary much easier." (SnackCo)

Given the previous observations that people are not using the functionality provided by these tools, the fact that they have also received only basic, mechanical training, would tend to indicate that the training is not adequate.

"Training was not very good, but we figured it out." (MedCons)

4. Evolution. After an initial introduction into the use of a groupware tool, the users we interviewed tended to "practice" only those procedures that they needed to accomplish their most urgent business tasks. As a result, much of what they were initially trained to do but did not continue to do regularly was forgotten.

"Two weeks after the training program I could barely remember how to get to my file directory." (LawCo)

In the use of any system, people will encounter special case needs for functions from time to time in their work. Those interviewed did not regularly look up procedures in a manual when these situations arose. When online help was available, most who used it were unable to find what they needed. Instead, the typical form of help sought was to ask a colleague or subordinate.

"I refuse to read manuals and documentation; they aren't even written in English!" (BigChem)

"The only copy of the manual I could find was two years old and inappropriate to the version I am using." (SoapCo)

"On-line 'Help' is a bust. It never covers the exact problem I'm having and is written with lots of jargon." (FoodCo)

"I always ask Joe for help. He can tell me in two seconds where I've gone wrong." (BigU)

"Sue explains my mistakes in the context of our work. That makes it easier for me to remember for next time." (TerminalCo)

Some of the organizations provided a person or group to serve as the designated support source to which the users would turn for help. These organizations appeared to understand the evolutionary nature of a person's use of software, and they supported that evolution through a formal organizational entity. Other sites we studied assumed that once the initial training had taken place, there was no formal corporate role of an ongoing nature. In these cases, *de facto* support grew up in the form of individuals in work groups who became "local gurus."

"Dick has become the guy we all go to for help. He's part of our department and understands our questions best." (TerminalCo)

"The Infocenter has been wonderful in supporting the use of this tool. They are always available and polite in telling you where you made your mistakes." (OilCo)

We observed what might be called a "plateau of competence" in using a tool. Without a timely and user-appropriate incentive to move beyond self-standardized use, people tend to settle into standard operations (Rosson, 1985). We observed close group interaction serving as a constructive stimulus for individuals. In SnackCo a central person sent out a newsletter of hints and ideas that was found useful by some. However, the presence of new ideas was countered by pressure to "get the job done," so many people found little time to try new things. This suggests that such stimuli must be in the form of easily tried procedures with immediately visible value so that they fit into the practices carried out during a busy day.

We conclude that, in each of the categories - champions, expectations, training, evolution - the need for sensitivity to organizational issues is evident. In addition the degree and timing of organizational intervention must be planned. Without attention to the organizational impacts of introducing a technology, the risk of failure is increased because the complexity of factors influencing the use of the technology is not being considered.

IV.2.4. Process redesign may be required to realize productivity improvement.

We have just suggested that organizations should consider the perspectives of people when introducing technology. Another interesting question is to what extent do organizations need to alter their basic processes for accomplishing work in order to achieve higher levels of coordination and productivity.

This process redesign may occur on a variety of levels. For example, traditional process redesign looks at formal processes which have been established in an organization in order to achieve its business goals and objectives. These processes are reevaluated, for example, in light of changes in products or services, changes in the structure of the industry, or the impacts of new technology on basic functions (e.g., manufacturing or distribution channels).

However, process redesign can be employed on a much more local level in an organization. For example, the process of work coordination in a department or the process of conducting meetings may be areas in which productivity gains could be achieved through rethinking and redesigning the traditional forms (e.g., Whiteside and Wixon, 1988). In our field work we observed instances of management expecting substantial productivity improvement to result from the simple act of putting a groupware system into place. In these instances our interviews did not uncover any significant change in how people approached their jobs. Some felt that the new technology created more work for them and therefore made them less productive.

Whenever we observed the implementation of groupware technology without a concurrent examination of how work procedures and coordination should perhaps change or evolve, we saw that these systems had very little impact on the perceived productivity of the groups. These observations lead us to the conclusion that in some cases when groupware systems are implemented, not enough attention is being placed on examining the basic processes of work and how technology may enhance these processes. Therefore, process redesign may be required to achieve productive benefits in using groupware technology.

IV.2.5. Creating productive teams is a challenge.

Managers in some of the organizations we studied had explicit goals of changing the way work was carried out, moving their groups to new planes of performance, creating "paradigm shifts":

"I am intrigued by the linguistic theory underlying The Coordinator and would like to see everyone undergo a paradigm shift and significantly change the way they interact." (SnackCo)

Does the current generation of groupware systems facilitate this process? What is truly needed to create productive teams? In *TeamWork* (Larson and LaFasto, 1989), the authors present eight characteristics of high performing teams which they draw out of interviews with publicly acclaimed high performing teams, including sports, science and technology, and industry. The eight characteristics are shown in Table 6. Most of these appear to reflect generally understood notions of good team work, and they are described at a somewhat abstract level. However, they serve the purpose of making these critical elements visible and keeping them at hand for managers to think about and use.

They also raise many questions in terms of how these characteristics are operationalized. In the context of our research, how can technology be applied to facilitate the creation of these key elements?

The partnership of organizational process and technology is very clear. Management must carry out specific tasks to bring forth these productive team characteristics. All of these things can be accomplished without any technology. However, in the fast-paced, geographically-dispersed environment of today's corporation, groupware technology could enhance the individual's ability to carry out the appropriate tasks.

Examining people's attitudes appears to be an important step in understanding barriers to productive team work. In our interviews we noted that when people saw the immediate value to themselves of using a function (e.g., messaging) they quickly adapted to its use. However when it was in the interests of the "higher good" - that is the team, department or organization would benefit - the incentive for the individual was missing. In these situations it took other motivators to cause people to use these tools. Some of the motivators included:

- ▶ A charismatic leader
- ▶ Orders from higher management
- ▶ Workshops on organizational issues
- ▶ Obtaining group agreement and individual permission

In other words, the technology alone, regardless of its potential value, attractiveness, or ease of use, could not inspire people to use it. In addition, introducing new technology into a poorly operating work group is unlikely to improve its performance. In fact researchers have found that new technology, may very well degrade performance because its introduction brings more complexity and a threat to the people on the team (Henderson and Cooprider, 1988).

The well-known concept of "unfreezing" in organizational change theory (Lewin, 1952) seems applicable here. The potential users of groupware systems need to "open up" or "unfreeze" to the possible value of learning to use the technology. That unfreezing is not a simple matter of mechanical training, but rather an organizational process that includes training, education, and rethinking the goals of the team, and then considering how work results will be accomplished from the new perspective.

GROUPWARE

Characteristics of High Performing Teams

- ▲ A Clear Elevating Goal
- ▲ Results-Driven Structure
- ▲ Competent Team Members
- ▲ Unified Commitment
- ▲ Collaborative Climate
- ▲ Standards of Excellence
- ▲ External Support and Recognition
- ▲ Principled Leadership

Source: Larson & LaFasto, 1989

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Table 6

One of the lessons that comes out of *TeamWork* is that much of the success of teams depends on communication among team members on key issues. One of groupware's greatest values, according to our research, is the support it provides for electronic messaging. Our conclusion here is that if groupware systems can facilitate team interaction in some of the items shown in Table 6, it has the potential to move group work into the realm of high performance teams.

V. Summary

Is groupware too new to study conclusively? We have learned from innovation research (Rogers, 1983) that it takes time for new ideas to be assimilated by people. Although the technology for electronic mail and conferencing has been available for fifteen years, the concept of technology to support work groups has only been discussed for about four years.¹ We may therefore be observing the use of these new tools when they are in their infancy and before people have learned to think about them as essential tools for effective office work.

Nonetheless, experiences gained from studying people as they learn to use new tools can benefit the designers of the next tool generation, thereby helping to accelerate the process of acceptance and use of these tools. We also believe that managers can learn to be sensitive to the complex balance that exists between the organization and the technology.

Our observations were consistent across a wide range of organizations. Work groups at the largest organization we studied, BigChem with \$30 billion in revenues,

¹The pioneering work done by Doug Engelbart (in the early 1960's) on high performing teams is the forerunner of the groupware concept. However this work is not well known to the general public.

experienced the same challenges in organizing work and using information technology as did those at the smallest organizations. Work groups at companies recognized as being "forward thinking", "networked," and participatory in management style did not differ in their problems nor in their attempted solutions from work groups in companies characterized as "conservative", hierarchical, and traditional in management style.

For example, CableCo (\$1 billion in revenues) is a very young, quickly growing, highly successful company with a participatory management style. The work group consisted of nine people who had concerns related to effective communication and management of tasks in an accelerating, fast-paced, environment that spanned several time zones. At SoapCo (\$17 billion in revenues) one work group consisted of fifteen people who expressed exactly the same concerns and were attempting to use information technology in the same way to support their work group. SoapCo is a very old company with a long tradition of hierarchical, conservative management, and with long-standing procedures for accomplishing tasks. *A priori*, we might have assumed differing environments in these two organizations, and these factors would have dictated different approaches to solving the coordination problems. We did not find this to be true here nor at other research sites. Apparently today's business environment of global, 24-hour marketplaces with the concurrent acceleration of information and coordination needs brings the same challenges in managing work groups to diverse organizations.

We have discussed major questions and conclusions about work groups and their use of information technology (summarized in Table 7). We must not overlook the possible interplay of factors in our major conclusions. For example, the fact that groupware is a relatively new technology may account for why people seemed to need more extensive training and introduction than the simple mechanical instruction that accompanies these tools. In the future, as the tools are more widely known and used, their inherent value may become more obvious to people and they therefore will adapt to their use more easily.

However, the organizational inhibitors that we observed cannot be dismissed. Recognizing the long-lasting constraints of history and the power of politics in the organization at the same time as considering the new possibilities for technology support may result in new insights. These contrast with insights suggested when using traditional requirements analysis, often focused on individual users to the exclusion of organizational factors. Understanding the interplay of:

- 1) economic balances (i.e., input resources versus output value) inherent in the use of a tool,
- 2) the differential impacts on organizational roles (i.e., managerial impacts may differ from support staff impacts) and,
- 3) the organizational readiness (i.e., management attention through planned change or intervention)

may lead management toward different technological paths than those discovered through simple analysis.

We have stated earlier that managing the volume of information has been traditionally, and still is, the major task facing knowledge workers. As we have interviewed, observed teams, and better understood the tasks they are undertaking, we have come to the conclusion that a groupware system like The Coordinator, for example, could have an effect on knowledge work. That is, The Coordinator, if it were used as its designers intended, could reduce the volume and complexity of information by compressing it through a focus on action-oriented conversations. This could support group members in focusing on results-related content and meaning in their communications. We explore this idea further in a second paper that focuses on The Coordinator and its underlying theory as an example (Bennett and Bullen, forthcoming).

Revolutionizing work may be the type of role groupware systems could come to have in organizations. Most groupware systems of today are not designed to do this. Instead they attempt to provide electronic versions of the tasks people are believed to

GROUPWARE

Summary of Conclusions

FROM A DESIGN PERSPECTIVE

1. Electronic message communication is the primary tool
2. Message linking is a key improvement provided by electronic communications
3. What functionality is included and how it is offered are important factors
4. Isolated tools hinder productive use of groupware systems

FROM AN ORGANIZATIONAL PERSPECTIVE

1. People report most value from tools that parallel their non-electronic activities
2. Benefits gained need to balance or outweigh the invested resource
3. Groupware implementation is simultaneously a social and technical intervention
4. Process redesign may be required to realize productivity improvement
5. Creating productive teams is a challenge

carry out in performing knowledge work in groups. If indeed the concept of work groups and business teams is the organizational concept of the future, it becomes critical to better understand the interaction of individuals in these groups, and the role that information technology can play in supporting or even enhancing the work of these groups.

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Appendix I

All-In-I™

All-In-I is more accurately described as a family of tools or even an office tool environment. This system resides on a centralized computer, with PCs often serving as a means of access (both locally and remote). It does not provide flow of data integration, but does provide flow of control within its environment. The basic tool provides a variety of functions ranging from electronic mail to a spread sheet package. An organization can customize All-In-I by adding other commercial products under the general All-In-I "umbrella." For example the popular word processing software, Word Perfect, can be installed to operate under All-In-I. The extent to which the functionality provided under All-In-I can be used as groupware depends on which functions are used and on what agreement the people in the organizational unit reach on how the functions will be used.

The logical groupware use of this tool involves employing the electronic mail function and Vax Notes (computer conferencing) for communication and the exchange of documents. A calendar function can be used for scheduling group meetings.

The basic All-In-I functions described above are in use at three organizations in our study.

ForComment™

ForComment is a single-purpose system. It assists users in group authoring or editing of documents. This system is available in single PC and local area network configurations. ForComment "imports" text produced in most of the popular word processing environments or ASCII and allows multiple authors or reviewers to rewrite and/or comment on the document. Control over the final version of the document always remains with one individual, the designated primary author. Proposed rewrites and comments are noted through a symbol in the margin, and the actual text of the revision is displayed in a second window on the viewer's screen. Each entry is identified by reviewers' initials, color coding, and date of entry. The software automatically merges entries from multiple reviewers so that the primary author reviews a single, aggregated version. In this respect ForComment provides flow of data integration.

ForComment is used by four organizations in our sample. Each organization uses it unmodified as provided by the vendor.

Higgins™

Higgins is a personal computer system based on a local area network that provides a variety of functionality including electronic mail, personal information organization, project tracking, and project expense tracking. The electronic mail function links messages and their associated replies, allowing users to trace the history of communications leading to a current message. All of the functions are integrated on Higgins both with respect to flow of control and to flow of data. For example, a user can employ key words to find all entries dealing with specific categories. Therefore the name "project xyz" can be used to find electronic mail, "to do" entries, expense reports, calendar entries, etc., that relate to that project by its code name. In this way Higgins can be used both as a personal organization tool and as a groupware tool.

Higgins is used in five of the organizations in our sample, in each case in a stand alone local area network (LAN) mode as provided by the vendor.

In-House System I

One large organization in our sample developed its own global electronic mail, conferencing, and document exchange system. This system resides on a mainframe computer and is accessed by PCs acting as workstations (both locally and remote). Both integration in terms of flow of data and flow of control exist to varying degrees in this system. Development of increased integration in both areas is a current priority. This system has been in worldwide use by a very large number of people at this organization for more than ten years.

In-House System II

One small organization in our sample developed its own relatively basic electronic messaging tool. This system resides on a centralized computer and is accessed by both local and remote PCs. The system is used primarily in the United States (although one European node is in place) and has been in use for approximately eight years.

Metaphor™

Metaphor provides high-end specialized, networked workstations and software to support professionals, managers, and executives in constructing complex queries against multiple data bases. Users build queries by specifying data elements graphically and then by linking sequences of operations on that data. These queries can be saved in "capsules" for later use or for use by others. Data results can be passed to others on the specialized local area network in the form of spread sheets, reports, and graphs.

The graphical user interface is intended for easy and effective use by business professionals (such as marketing analysts) who need to review and aggregate data extracted from large data bases. Flow of control and flow of data integration exist within the Metaphor environment.

Metaphor is in use at two sites in our sample. In one of those sites it is being used as a standalone system; in the other it is designed with a gateway into the corporate data network.

PROFTM

PROFS is a general purpose office system tool. This system resides on a centralized computer with PCs often serving as a means for access (both locally and remote). PROFS includes functionality for electronic mail, calendaring, reminders, and folders for mail management. Other than for the electronic mail component, the extent to which PROFS can be used as groupware depends upon the agreements people in an organization reach for allowing access to calendars and folders. Flow of control integration exists to a limited degree within the Profs environment.

PROFS was studied at two of our sites.

The Coordinator SystemTM (Version I)

The Coordinator System (TCS) is a groupware system which was designed to support people in effective action during the course of their work in an organization. The system is generally available in two hardware configurations: either on a PC/local area network, or via dial-up mode supported by the vendor. TCS differs from most of the other products we examined in that the software implementation is based on an underlying theory of human interaction. The theory suggests that the basic unit of interaction is a conversation, and that people use language (speech acts) to make requests, promise results, decline requests, declare commitments completed, etc. The software makes these distinctions visible and thereby is designed to encourage people to conduct their interactions in a way presumed (under the theory) to be more effective.

The Coordinator Version I is available in seven of the organizations in our sample. Technical details of the implementations differ (e.g. remote mail, local area network), but these differences do not play an important role in what the users see, or how they tend to employ the tool. The fact that Version I is the tool we studied is, however, important because the user interface of Version I differs significantly from that of Version II. Version II became available in 1989, and it is currently being marketed and used in a number of organizations.

The degree to which flow of control integration exists in a TCS implementation depends upon the nature of the implementation and bridges that have been established to other systems. Flow of data integration exists in some of the tools.

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